

## *Phauda bicolor* sp. n. from North Sumatra (Indonesia) (Zygaenidae: Phaudinae)

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**Abstract.** During an expedition to Sumatra in February and March 2002 the authors discovered an undescribed zygaenid moth: *Phauda bicolor*, sp. n. Forty five specimens were obtained. In order to clarify its systematic position one specimen was preserved in ethanol for molecular analysis. The male and female genitalia are illustrated. A potential related species from North India: *Phauda fuscalis* Swinhoe, 1892 is compared. DNA sequence of the mitochondrial gene cytochrome oxidase subunit I is included in the character set.

**Zusammenfassung.** Während einer Expedition im Februar und März 2002 konnten die Autoren eine Zygaenidae finden, welche sich als neue Art herausstellte: *Phauda bicolor*, sp. n. Fünfundvierzig Exemplare konnten gesammelt werden. Zur Klärung der systematischen Stellung wurde ein Exemplar in Alkohol für eine spätere DNA-Analyse aufbewahrt. Die männlichen und weiblichen Genitalien werden abgebildet. Eine Schwester-Art zu der neuen Art aus Sumatra ist von Nord-Indien beschrieben: *Phauda fuscalis* Swinhoe, 1892. Die DNA Sequenz des mitochondrialen Gens Cytochrom Oxidase Untereinheit I wird in das Merkmalsset aufgenommen.

### Introduction

With excellent help from the late Dr. E. W. Diehl, Pematang Siantar (N Sumatra), the authors visited some of the vanishing mountain rainforests in northern and western Sumatra. Between two collecting sites the authors stopped to admire and photograph an enormous tree of the Fig family (Fig. 1). In spider webs on the bark we found several specimens of a peculiar looking zygaenid moth. Soon we also discovered a number of live specimens under the tree's leaf-crown. When we returned, we stopped again by the tree and managed to collect more material, to preserve a specimen in ethanol; and look for larvae and food plant. Genitalia examination confirmed that the species can be associated with Phaudinae. The subfamily is only known from East- and Southeast Asia (Fänger et al. 1999; Holloway et al. 2001; Scoble 1992) from China to the Malay Archipelago (Alberti 1954). Phaudinae was established by Kirby (1892). Alberti (1954) discussed the systematic placement of *Phauda* Walker, 1854 and *Alophogaster* Hampson, 1892) in this subfamily. On the best available interpretation, we come to the conclusion that the moths collected on Sumatra belong to an undescribed species related to *Phauda fuscalis* (Swinhoe, 1892). Here we describe this new species. To complete the character set of the new species, we provide DNA sequence information as suggested by Tautz *et al.* (2003) & Knölke *et al.* (2005). DNA was extracted from thoracic muscle tissue of one paratype (sample ID: DNATAX02239) using Qiagen (Hilden, Germany) tissue kit according to manufacturers protocols. Mitochondrial (mtDNA) cytochrome oxidase subunit I (COI) gene was amplified with PCR using protocols and primers as in Simon *et al.* (1994). Direct sequencing of dye labelled (BigDye V2 ready reaction master mix, Applied Biosystems) templates was carried out using an ABI 377 auto-

mated sequencer (Applied Biosystems). Six single strand sequences were assembled to 1547bp of COI gene and the tRNA beforehand and aligned to the COI gene of *Bombyx mori* (Linnaeus, 1758) (Lepidoptera: Bombycidae; GenBank accession number NC\_002355). DNA is stored in the frozen DNA collection of the Zoologische Staatssammlung München under storage number DNATAX02239.



Fig. 1. The prominent Fig-tree on North Sumatra, with the authors and Günter Riedel. (photo: Tanja Kothe)



Figs 2–3. Spread specimens of *Phauda bicolor* sp. n. 2. Holotype, ♂. 3. Paratype, ♀. (photos: Ulf Buchsbaum)

### *Phauda bicolor* sp. n.

Figs 2, 3

**Material.** Holotype ♂ (Fig. 2): **Indonesia**, North Sumatra, Purba, 1 km South of Seribudolok, 2°54'59"N 98°38'24"E, 1380 m, 3.iii.2002, leg. Fibiger, Larsen & Buchsbaum, coll. ZSM. – Paratypes, 44♂ and ♀ (Fig. 3), same data as holotype (1♂ genit. prep. 4273, 1♀ genit. prep. 4274 M. Fibiger; 1♀ DNA ID-No.: DNATAX02239), coll. Fibiger, Larsen, Zoologische Staatssammlung München, Shen-Horn Yen, C. Naumann (Zoologisches Forschungsmuseum Alexander Koenig, Bonn), G. Tarmann, G. Tremewan.

**Diagnosis.** Wingspan: male 22–26 mm, forewing 10–13 mm; female 26–34 mm, forewing 13–16 mm. Proboscis rudimentary, less than 1 mm long. Labial palps 2-segmented, rudimentary, less than ¼ mm long; maxillary 1-segmented. Antennae thread-like, ciliate in both sexes. Ocelli absent. Chaetosemata present, relatively large. Head, antennae, eyes, thorax, and all scales on thoracic segments, legs and wings pitch black and more or less shining, though not on the wings. Both fore- and hindwings elongated, broadest at ¾. The forewing venation is with a full CuP. Scales on wings narrow, hair-like. Hindwings semitranslucent, Abdomen bright orange. The first two segments black dorsally; a black and quadrangular bar present dorsally on remaining segments. Underside of the abdomen bright orange. In *P. fuscalis* the abdomen is wholly black (Swinhoe 1892)). Male with two long, slightly orange coremata-brushes arising from the 8<sup>th</sup> segment laterally and posteriorly. The same brushes on



*P. fuscalis* are “fiery red hairs” (Swinhoe 1892).

Male genitalia (Fig. 4). Uncus large, broad, arrow-shaped; subapically spatulate; apically with a down-curved hooked tip. Tegumen broad, as long as vinculum. Saccus finger-like, almost as long as vinculum. Juxta circular. Fultura superior membranous, covered with diminutive spines. Valva broadest at base, attenuate at slightly upturned apex. Sacculus sclerotised at base. Clavus digitate, slightly setosed. Editum large, globular, dominating the valva, comprising hundreds of small circular cells with short hair-like scales. Valva with long, spreading hair-like setae. phallus long, narrow, tapered from mid coecum to apex. Vesica a little shorter than phallus, curving 90 degree dorsally; broadest 2/3 covered with numerous spicules out; on dorsal side from base to mid clothed with spicules.

Female genitalia (Fig. 5). Papillae analis lunar-shaped; the straight sides against each other. Posterior apophyses slightly longer than the ovipositor valves. The 8<sup>th</sup> abdominal segment slightly sclerotised. Anterior apophyses rather short, heavily fused to the 8<sup>th</sup> segment. Lamella postvaginalis prominent, ovoid, slightly sclerotised. The antevaginal plate small, sclerotised. Antrum with a ventral sclerotised plate, upon which the ductus seminalis arises. First third of ductus bursae almost straight; the second part tightly coiling ten times before the large globular corpus bursae.

Figs 4–5. Genitalia of *Phauda bicolor* sp. n. 4. ♂, 5. ♀.





**Figs 6 a–b.** Adults of *Phauda bicolor* sp. n. sitting in the ground vegetation close around the *Ficus* tree. (photo: Ulf Buchsbaum)



**Fig. 7.** Type locality of *Phauda bicolor* sp. n. shown on the map for North Sumatra (Indonesia).

Cytochrome oxidase subunit I (COI-5P).

*Phauda bicolor* sp. n. (Sample ID: AJ556909; Barcode ID: GBGL0272-06; GenBank Accession: AJ556909; Residues: 901; Comp. A: 294; Comp. G: 135; Comp. C: 133; Comp. T: 336; Ambiguous: 0):

CGAAATGATTATTTTCCACAAATCATAAAGATATTGGAACATTATATTTTATTTTGAATTTGAACAGGAATA  
 GTAGGAACCTCTTTAAGTCTATTAATTCGAGCAGAATTAGCTAACCCAGGATCTTTAATTGGAAAT---GATCAA  
 ATTTATAATACAATTGTTACAGCTCATGCTTTTATTATAATTTTTTTTATGTTTATACCAATTATAATTGGAGGA  
 TTTGGAAATTGATTAGTACCTTTAATATTGGGAGCCCTGATATAGCATTTCCACGAATAAATAATATAAGATTT  
 TGACTTCTTCCCCCTCATTTATACTTTTAATCTCAAGAAGAAATGTTGAAAATGGAGCAGGAACAGGATGAACA  
 GTTTACCCCCACTTTTCATCAAAATATTGCCCATAGAGGAAGATCAGTTGATTTAGCAATTTTTTCCCTTACACTTA  
 GCAGGAATCTCTCAATTTTAGGAGCTATTAATTTTATTACCACAATTATAATATACGACCTAATAATATAATA  
 TTTGATCAAATACCATTATTTATTGAGCTGTAGGAATTACAGCTTTACTTTTACTTTTATCATTACCAGTATTA  
 GCTGGGGCTATTACTATACTACTTACAGATCGAAATTTAAATACTTCATTTTTTGATCCTGCAGGGGGTGGTGAT  
 CCAATTTTATATCAACATTTATTTTGATTTTTTGGTCATCCTGAAGTTTATATTCTAATCTCCCAGGATTTGGA  
 ATAATCTCACACATTATTTCCCAAGAAAGAGGTAAAAAGAACTTTTGATGCTTAGGAATAATTTATGCTATA  
 ATAGCAATTGGTTATTAGGGTTGTAGTTGAGCTCACCATATATTTACAGTAGGAATAGATATTGATACTCGA  
 G

*Phauda mimica* Strand, 1915 (Sample ID: LS-06-0055.1; Barcode ID: LEFIA1293-10;  
**GenBank Accession:** -; Residues: 670; Comp. A: 208 ; Comp. G: 97 ; Comp. C: 98 ;  
 Comp. T: 265 ; Ambiguous: 0):

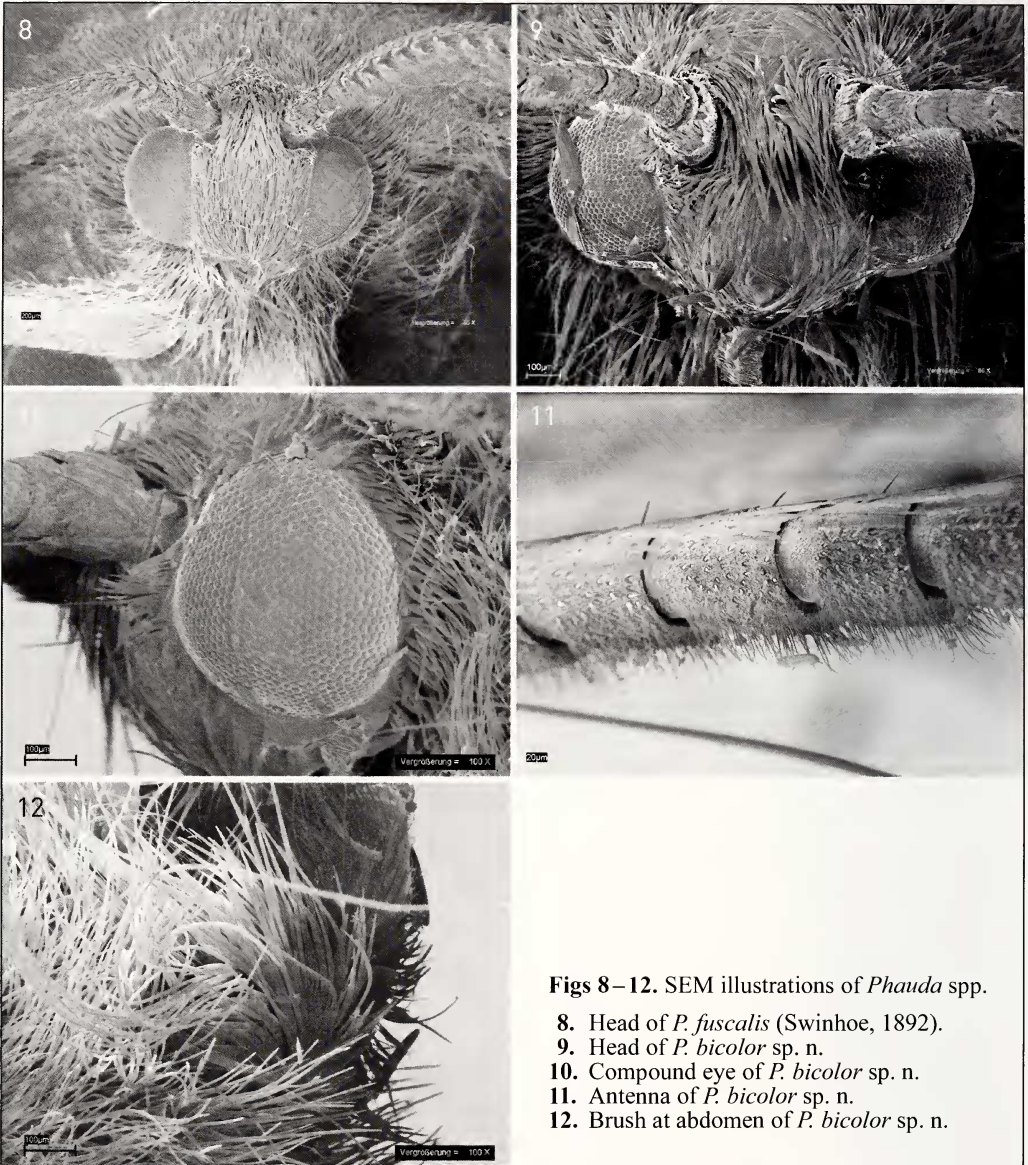
GAACATTATATTTTATTTTGAATTTGAGCAGGAATAATTGGAAC-TCTT-AAGTTTATTAATTCGAGCAGAAC  
 TGGGAAATCCAGGATCTCTTATTGGTAATGATCAAATTTATAACACAATTGTACAGCTCATGCTTTATTATAA  
 TTTTTTTTATAGTTATACCAATTATAATTGGAGGATTTGGTAATTGATTAGTACCATTAATATTAGGAGCTCCTG  
 ATATAGCATTTCCACGAATAAATAATATAAGATTTTGACTTCTACCTCCCTCATTAATACTTTTAATTTCAAGTA  
 GAATTGTTGAAAATGGAGCAGGTACCGGATGAACAGTTTACCCCCACTTTTCATCTAATATTGCTCATAGAGGTA  
 GTTCAGTTGACTTAGCAATTTTCTTTACATTTAGCAGGAATTTCTCAATTTTAGGAGCTGTAAATTTTCATCA  
 CTACAATTATTAATATACGACCTAATAATATAACATTTGATCAAATACCTTTATTTGTTGAGCTGTTGGAATTA  
 CAGCTTTATTATTATTATTATCTTTACCAGTATTAGCTGGAGCTATTACTATATTACTTACAGATCGAAATTTAA  
 ATACTTCTTTTTTTGATCCTGCAGGAGGTGGAGATCCTATTTTATATCAACATCTATTTTGATTTTTTTGG

**Bionomy.** We suggest that the habitat for the moth is in the leaf-crown of fig trees. The authors probably found a relict population in a tree surviving from the once undisturbed rainforest. The moths were diurnal, flying in early March. Figs 6 a, b show two living specimens at the type locality on 03 March 2002 in the ground vegetation close around the *Ficus* tree. The larvae of *Phauda* are possibly specialists on Moraceae (Fänger et al. 1999, Holloway et al. 2001)

**Distribution.** *Phauda bicolor*, sp. n. is only known from the type locality. The authors believe it will not be easy to find it elsewhere. On Fig. 8 the type locality is represented on the map of Sumatra.

**Remarks.** The systematic position of Phaudinae remains controversial. The taxon comprises approximately 50 species, all occurring in South East Asia (Epstein et al. 1999). Phaudinae is recognised by the absence of ocelli; the well developed chaetosemata; the elongated, narrow forewing; the translucent, sometimes spiralled ductus bursae; and the bipectinate (male) or biserrate (female) antennae. However, the antennae of both the male and female are ciliate in *Phauda bicolor* sp. n. One of the characters of the Phaudinae is the only distally present CuP of the forewing; however, in *Phauda bicolor* sp. n. the CuP vein matches those of the Zygaeninae, Chalcosiinae, and Procridinae. The hindwing venation in *Phauda bicolor* sp. n. has a full CuP, which is distally stalked with Cu2. The pair of hairs at the posterior abdomen, which is characteristic for Phaudinae, is present in *P. bicolor* sp. n.





**Figs 8–12.** SEM illustrations of *Phauda* spp.

- 8. Head of *P. fuscalis* (Swinhoe, 1892).
- 9. Head of *P. bicolor* sp. n.
- 10. Compound eye of *P. bicolor* sp. n.
- 11. Antenna of *P. bicolor* sp. n.
- 12. Brush at abdomen of *P. bicolor* sp. n.

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